SOME TERTIARY PELECYPODA FROM THE LAKES ENTRANCE OIL SHAFT, GIPPSLAND, VICTORIA

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Introduction

The Lakes Entrance Oil Shaft is situated about 2 miles northeast of Lakes Entrance township in the Parish of Colquhoun and about 200 miles east of Melbourne. The Shaft was sunk under the auspices of the Commonwealth and Victorian Governments from 1941 to 1944, operations ceasing when it had reached the depth of 1,212 feet.

Apart from a few feet of soil the Shaft was sunk in Tertiary sediments and as approximately 12,000 tons of material were removed during the mining operations, a unique opportunity was afforded the palaeontologist to collect suites of fossils from the various stratigraphic horizons through which the Shaft passed. The writer paid frequent visits to the scene of operations to collect fossiliferous material and to make field observations on the lithology of the beds. The stratigraphic sequence of beds was characteristic of that already put forward by the writer for the Gippsland area (Crespin, 1943). The greenish-grey marls and sandstones of the Kalimnan (Lower Pliocene) passed downwards into the transition stage, the Mitchellian (Upper Miocene) then into the typical bryozoal limestones and marly limestones of the Balcombian and the brownish marls, sandy marls and glauconitic sandstone of the Janjukian (Middle Miocene).

Megafossils were numerous in the Kalimnan and Janjukian stages, but in the Balcombian stage, except in that part referred to the Bairnsdale substage (Crespin, 1943) they were scarce. Despite the number of megafossils in the Janjukian sediments, it was difficult to extract complete specimens.

Four new species and six well-known but rarely figured species of pelecypoda are described in the paper from the Kalimnan, Balcombian and Janjukian deposits in the Lakes Entrance Shaft. The majority of them are typical of outcrops of Tertiary rocks in the Lakes Entrance area and in other parts of Victoria. The species and the respective horizons from which they are described are :

Kalimnan

Cucullaea praelonga Singleton
Spondylus pseudoradulus McCoy
Eucrassatella kingiculoides (Pritchard)
Antigona (*Proxichione*) *cognata* (Pritchard)
Trachycardium (*Ovicardium*) *gippslandicum* sp. nov.
Panope kalimnensis sp. nov.

Balcombian

Serripecten yahliensis (T. Woods)
Hinnites corioensis McCoy

Janjukian

Atrina janjukiensis sp. nov.
Lentipecten victoriensis sp. nov.
Venericardia janjukiensis Chapman and Singleton

The author's thanks are extended to Dr. J. Marwick of the Geological Survey of New Zealand for helpful criticism regarding generic names and for specimens of New Zealand species for comparative purposes. The excellent photographs were prepared by Mr. E. Crisp, Department of the Interior, Canberra.

All specimens are housed in the Commonwealth Palaeontological Collection at Canberra.

Description of Species

Family CUCULLAEIDAE

Genus **Cucullaea** Lamarck 1801

Cucullaea praelonga Singleton
(Pl. XV, Fig. 12)

Observations. A well preserved, gerontic, right valve of *C. praelonga* is figured from the greenish grey sandstone typical of the Kalimnan stage in the Shaft. Two other right valves were also found. The species was originally described from the Kalimnan at ' Forsyth's,' Grange Burn near Hamilton, Western Victoria. The figured valve and one of the other specimens are slightly less quadrate in outline than the type, but the third and smaller one is typical. However, Singleton notes that the outline is variable. All valves are rather coarsely ornamented which helps to distinguish the species from *C. corioensis*

The dimensions of the figured specimen are : length, 65 mm., height, 55 mm., thickness of single valve, 28 mm.

Occurrence. In greenish grey, glauconitic sandstone at the depth of 100 feet. Comm. Pal. Coll. No. F.11,993, Type No. 629.

Age. Lower Pliocene (Kalimnan Stage).

Family PINNIDAE

Genus **Atrina** Gray 1847

Atrina janjukiensis sp. nov.
(Pl. XVII, Figs. 18, 19, 20.)

Holotype. Shell thin, incomplete, equivalved in oblique direction, triangular, elongate, nacreous layer entire. Anterior-ventral border straight. Valves convex, increasing in width towards posterior end, where agape. Rhomboidal in section. Dorsal portion of valve about two-thirds of total width at posterior end. Dorsal valve ornamented with 14 smooth longitudinal ribs, increasing in breadth posteriorly, with shallow interspaces becoming very broad in that direction. Ventral half covered with numerous close-set concentric ribs, which commence along ventral margin near apical end. Dorsal margin straight, sharp, slightly concave near the byssal orifice, becoming convex towards posterior end. Ventral margin gently convexly curved towards posterior end where maximum length.

Height, 125 mm. ; length at anterior (at broken portion) 25 mm. ; length at posterior circ. 90 mm. ; dorsal margin 95 mm. ; ventral margin 86 mm. ; greatest thickness through both valves 45 mm. ; thickness at anterior, 20 mm. All measurements are approximate only because of the broken shell and mode of preservation.

Paratype. Shell crushed, but characters all present. Portion of outer shell on anterior dorsal showing fine rib between two stronger ones.

Height, 115 mm. ; length at anterior, 5 mm. ; length at posterior 70 mm. ;

dorsal margin 105 mm. ; ventral margin, 82 mm. As in holotype all measurements are approximate.

Observations. Both the holotype and paratype of *Atrina janjukiensis* were found in hard, concretionary, calcareous sandstone and consequently their extraction from the matrix was extremely difficult. Indications are that the holotype, if complete, should have a height of circ. 150 mm. with the dorsal margin measuring circ. 110 mm. Fragments of the anterior portion of the shell were found in the more friable micaceous sandy marls with which the hard calcareous sandstone occurs as 'floaters.' *A. janjukiensis* resembles *A. cordata* (Pritchard) but it differs from that species in its greater height and broader and flatter valves.

Occurrence. In hard calcareous sandstone, at 1,048 feet. Holotype Comm. Pal. Coll. No. F.15,515, Type No. 630. Paratype, Comm. Pal. Coll. No. F. 15,642, Type No. 631.

Age. Middle Miocene (Janjukian Stage).

Family PECTINIDAE

Genus **Lentipecten** Marwick 1928

Lentipecten victoriensis sp. nov.
(Pl. XV, Figs. 8, 9, 10, 11)

Holotype. Shell, brown in colour, moderately large, compressed, thin, polished, suborbicular. Right valve gently convex. Surface covered with very fine concentric lines. Stronger concentric growth lines towards periphery. Ears equal in size, covered with fine almost vertical lamellae and with straight dorsal margin. Left valve almost flat, with slight convexity in area immediately below umbo. Surface covered with very fine concentric lines, with strong concentric growth lines towards periphery. Faint, flat radial ribs on anterior and posterior just below hinge line. Ears unequal, covered with lamellae which are curved on anterior ear. Margins curved. Lamellae form a serrated fringe on slightly curved dorsal margin. Posterior slightly larger than anterior.

Height, 73 mm. ; length 75 mm. ; thickness of two valves, 15 mm.

Paratype. Right valve. Shell broken, but all external characters as in holotype. Internal surface of shell smooth. Adductor scar large.

Height, 68 mm. ; length, 68 mm. ; thickness of single valve, 5 mm.

Observations. Tate referred a smooth shell from the Australian Tertiaries to the New Zealand Tertiary species *Pecten hochstetteri* Zittel, but Marwick (1924) stated that Tate was mistaken in thinking that species had two smooth valves. The smooth form from New Zealand is *P. huttoni* Park. There is little doubt that the Australian form is a new species and distinct from the New Zealand one. Consequently a new name *Lentipecten victoriensis* is given to the shell referred by Tate to *P. hochstetteri*.

Numerous specimens of *L. victoriensis* were present in the micaceous marls and sandy marls of Janjukian age in the Lakes Entrance Shaft, but because of the fragile nature of the shell complete specimens were difficult to collect. Valves were also present in the hard bands of concretionary sandstone, which are characteristic of the Janjukian Stage in the Lakes Entrance area.

Occurrence. Holotype from brown micaceous marls at 1,020 to 1,060 feet. Comm. Pal. Coll. No. F.16,098, Type No. 632. Paratype at similar depth. Com. Pal. Coll. No. F.15,449, Type No. 633.

Age. Middle Miocene (Janjukian Stage).

Genus **Serripecten** Marwick, 1928

Serripecten yahliensis (T. Woods)
(Pl. XVI, Figs. 14, 15)

Pecten yahliensis T. Woods, 1865, pl. 1, figs. 4*a*, *b*.

Observations. The figured specimen of this handsome species is the only complete example to be found in the sediments from the Lakes Entrance Shaft although complete and broken single valves are common in the beds which represent the Bairnsdale substage of the Balcombian (Crespin, 1943). Numerous specimens of the species were present at the depth of 320 feet where they were associated with an assemblage of macrofossils including *Clypeaster gippslandicus* McCoy and *Hinnites corioensis* McCoy, which is characteristic of the Bairnsdale substage. One specimen was recorded at the depth of 547 feet in the Batesford substage. The valves were always bluish grey in colour.

S.yahliensis was originally described from a well at Yahl near Mt. Gambier, South Australia.

The dimensions of the figured specimen are : height, 110 mm., length, 120 mm., thickness of valves, 35 mm.

Occurrence. In grey, bryozoal limestone at 325 feet. Comm. Pal. Coll. No. F.12,040, Type No. 634.

Age. Middle Miocene (Balcombian Stage, Bairnsdale substage).

Genus **Hinnites** de France

Hinnites corioensis McCoy
(Pl. XV, Fig. 13)

Hinnites corioensis McCoy, 1876, p. 31, pl. 58, figs. 1-5 ; 1885, p. 116, pl. 18, fig. 4.

Observations. *H. corioensis* is a typical species of the Bairnsdale substage of the Balcombian (Crespin, 1943). Species were found in the Shaft between the depths of 208 feet and 428 feet. It occurs commonly in the cliffs at Pound Swamp, Mitchell River, Bairnsdale, which is the type section for the Bairnsdale substage and at other localities along the Mitchell. It is also common in the road cutting at Toorloo Arm on the Princes Highway northeast of Lakes Entrance and in cliff sections along the Snowy River near Orbost.

The dimensions of the figured specimen are : height, 85 mm., length 80 mm., greatest thickness of single valve, 25 mm.

Occurrence. In pale grey bryozoal limestone at 281 feet. Comm. Pal. Coll. No. F.12,084. Type No. 635.

Age. Middle Miocene (Balcombian Stage, Bairnsdale substage).

Family SPONDYLIDAE

Genus **Spondylus** Linne 1758

Spondylus pseudoradulus McCoy
(Pl. XIV, Figs. 1, 2)

Spondylus pseudo-radula McCoy, 1876, p. 17, pl. 45, figs. 2, 2*a-c*.

Observations. A large left valve of *S. pseudoradulus* is figured from the Kalimnan sediments in the Shaft, and several fragments of large specimens were also found. The species is also recorded from bores in the Lakes Entrance

area. Although McCoy described the species from Miocene beds, he recorded large specimens from the Older Pliocene.

The dimensions of the figured specimen are : Height, 90 mm., length, 80 mm., thickness of valve, 25 mm.

Occurrence. In greenish grey glauconitic sandstone between the depths of 50 to 100 feet. Comm. Pal. Coll. No. F.12,010, Type No. 636.

Age. Lower Pliocene (Kalimnan Stage).

Family CRASSATELLIDAE

Genus **Eucrassatella** Iredale 1924

Eucrassatella kingiculoides (Pritchard)

(Pl. XIV, Fig. 6)

Crassatella kingiculoides Pritchard, 1903, p. 94, pl. 13, figs. 1, 2, 3.
Eucrassatella kingiculoides Singleton 1943, p. 258.

Observations. The figured specimen is complete and fairly well preserved. Numerous specimens were present in the Kalimnan beds in the shaft, the largest, a single valve, having a height of 63 mm. and length of 95 mm. *E. kingiculoides* is common in certain Kalimnan deposits in the Lakes Entrance area as at Jemmy's Point and Maringa Creek sections.

The dimensions of the figured specimen are : height, 60 mm., length 85 mm., and thickness through both valves, 45 mm.

Occurrence. In greenish grey, glauconitic sandstone at the depth of 100 feet. Comm. Pal. Coll. No. F.11,970, Type No. 637.

Age. Lower Pliocene (Kalimnan Stage).

Family CARDITIDAE

Genus **Venericardia** Lamarck 1801

Venericardia janjukiensis Chapman and Singleton

(Pl. XIV, Fig. 7)

Venericardia janjukiensis Chapman and Singleton, 1927, p. 120, pl. 11, figs. 30*a*, *b*, 31.

Observations. *V. janjukiensis* is a common species in the fine-grained, brown, micaceous marls and sandstones and in the underlying green glauconitic sandstone which comprise the Janjukian Stage in the Lakes Entrance Shaft and in bores in the area. A left valve is figured from the micaceous sandstone. It has slightly fewer ribs than the type specimen but all other features described by Chapman and Singleton including the humpiness in the ephebic stage, are present. It was difficult to obtain well preserved specimens in the glauconitic sandstone, but all forms were apparently large one having a height of 47 mm. and length of 52 mm. The larger size of the shells in the glauconite, which was formed under moderately shallow-water conditions, is in contrast to the smaller specimens present in the overlying fine-grained brown micaceous sandstone which was deposited in deeper water.

The dimensions of the figured specimen are : height, 36 mm., length 34 mm., and thickness of single valve, 14 mm.

Occurrence. In fine-graded brown, micaceous sandstone at 1,060 feet. Comm. Pal. Coll. No. F.15,638, Type No. 638.

Age. Middle Miocene (Janjukian Stage).

Family VENERIDAE

Genus **Antigona** Schumaker 1817

Subgenus **Proxichione** Iredale

Antigona (Proxichione) cognata (Pritchard)
(Pl. XIV, Fig. 5)

Chione cognata Pritchard. 1903, p. 101, pl. 12, Fig. 5.
Antigona (Proxichione) cognata Singleton. 1943, p. 254.

Observations. Large specimens of this species were collected in the Kalimnan deposits in the Shaft. In the majority of these the strong concentric frills shown in the type specimen, which was described from Grange Burn below Forsyth's near Hamilton in Western Victoria, are not well preserved but towards the ventral margin they develop into thick ridges medially and according to Pritchard ' taper to crenulate frills towards the anterior and posterior of the shell. The inner margin is finely denticulate, the denticulation slanting under the umbo and extending to the top of the posterior angulation.'

The dimensions of the figured left valve are : height, 63 mm., length, 72 mm., thickness of single valve, 25 mm. Measurements of another specimen are: height, 70 mm., length, 80 mm., and thickness of single valve, 30 mm.

Occurrence. In greenish grey, glauconitic sandstone, between the depths of 50 and 100 feet. Comm. Pal. Coll. No. F.12,017, Type No. 639.

Age. Lower Pliocene (Kalimnan Stage).

Family CARDIIDAE

Genus **Trachycardium** Moerch 1853

Subgenus **Ovicardium** Marwick 1944

Trachycardium (Ovicardium) gippslandicum sp. nov.
(Pl. XIV, Figs. 3, 4)

Holotype. Shell large, thick, obliquely high, oval. Only portion of shell structure remains but shape complete. Left valve almost complete. Forty seven radial ribs, flatly rounded, with deep interstices, narrower in width than rib. Ribs later becoming ornamented with fine tegulation, and spinose on posterior margin. Flattened area along posterior margin for length of about first 10 ribs. Ribs slightly angular and spinose in this area. Lunule slightly concave.

Height of shell, 43 mm. ; length, 35 mm. ; thickness, 26 mm.

Paratype. Right valve. Fifty-two flattened to rounded ribs, well preserved portions being covered with fine tegulate ornament. Posterior margin flattened for about length of first 10 ribs. Strong anterior cardinal, small posterior. Inside margin of shell strongly crenulate.

Height of valve, 40 mm. ; length, 33 mm. ; thickness, 11 mm.

Observations. The present species came from the Kalimnan deposits in the Shaft, only two specimens were discovered and both were incomplete. Marwick (1944) gives the age for the subgenus *Ovicardium* as Pliocene but suggests that it may have existed before that time. There is no other record of the species in Gippsland in the Commonwealth Palaeontological Collection.

Occurrence. In greenish grey glauconitic sandstone between the depths of 50 to 100 feet. Comm. Pal. Coll. No. F.11,973, Type No. 640. Paratype. Comm. Pal. Coll. No. 16,099, Type No. 641.

Age. Lower Pliocene (Kalimnan).

Family HIATELLIDAE

Genus **Panope** Menard 1807

Panope kalimnensis sp. nov.
(Pl. XVII, Figs. 19, 20)

Holotype. Shell broadly oblong, inaequilateral, convex, gaping at both ends. Shell covered with fine concentric lines which are grouped at irregular distances to form ridges. Anterior margin rounded, posterior attenuated and slightly truncated. Anterior and posterior equally broad. Dorsal margin straight; ventral straight but with slight fold toward centre. Shell minutely granulated. Umbos incurved. One cardinal tooth on each valve, only feebly interlocking. Nymph well marked.

Height, 50 mm.; length, 80 mm.; thickness of both valves, 45 mm.

Observations. *Panope kalimnensis* is common in the Kalimnan beds in the Lakes Entrance Shaft. The smallest specimen had a height of 45 mm. and length of 70 mm., and the largest, a height of 52 mm. and a length of 83 mm.

Tate (1887) figured a specimen of *Panope* from the River Murray Cliffs near Morgan, which belong to the Balcombian Stage and which he referred to the New Zealand species *P. orbita* Hutton. Marwick (1924) declared that *P. orbita* did not occur in Australia, and Finlay (1926) stated that all specimens he had seen from the Australian Tertiaries were consistently like Tate's figure given in 1887. He named the Australian Miocene species *P. ralphi*, designating Tate's Fig. 3, pl. 18 as the holotype. Specimens from the Kalimnan in the Dennant Collection, National Museum, Melbourne, are also labelled '*P. orbita*.' However, a close examination shows them to be similar to those found in the Kalimnan beds in the Shaft.

Four prominent features distinguish *P. kalimnensis* from *P. ralphi*. (1) the broadly oblong shape of the shell; (2) the truncated posterior margin of the former; (3) the slight fold towards the ventral margin of the shell; (4) the straight ventral margin.

Occurrence. Lakes Entrance Shaft, at 50 feet. Comm. Pal. Coll. No. F.12,015, Type No. 642. Also in No. 6 Bore, Ph. Colquhoun at 281 feet.

Age. Lower Pliocene (Kalimnan Stage).

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Explanation of Plates

Plate XIV

Fig. 1. *Spondylus pseudoradulus* McCoy. External, left valve. 2/3 natural size.
Fig. 2. *Spondylus pseudoradulus* McCoy. Internal, left valve.
Fig. 3. *Trachycardium* (*Ovicardium*) *gippslandicum* sp. nov. Holotype, left valve. 2/3 natural size.
Fig. 4. *Trachycardium* (*Ovicardium*) *gippslandicum* sp. nov. Paratype, right valve. 2/3 natural size.
Fig. 5. *Antigona* (*Proxichione*) *cognata* (Pritchard). Left valve. 2/3 natural size.
Fig. 6. *Eucrassatella kingiculoides* (McCoy). Right valve of complete specimen. 2/3 natural size.
Fig. 7. *Venericardia janjukiensis* Chapman and Singleton. Left valve. Natural size.

Plate XV

Fig. 8. *Lentipecten victoriensis* sp. nov. Holotype. Right valve.
Fig. 9. *Lentipecten victoriensis* sp. nov. Holotype. Left valve.
Fig. 10. *Lentipecten victoriensis* sp. nov. Paratype. Right valve.
Fig. 11. *Lentipecten victoriensis* sp. nov. Internal of right valve.
Fig. 12. *Cucullaea praelonga* Singleton. Right valve.
Fig. 13. *Hinnites corioensis* McCoy. Left valve.

Figures 2/3 natural size.

Plate XVI

Fig. 14. *Serripecten yahliensis* (T. Woods). Right valve.
Fig. 15. *Serripecten yahliensis* (T. Woods). Left valve.

Figures 2/3 natural size.

Plate XVII

Fig. 16. *Panope kalimnensis* sp. nov. Holotype. Left valve. 2/3 natural size.
Fig. 17. *Panope kalimnensis* sp. nov. Holotype. Incurved umbos and teeth. Dorsal margin.
Fig. 18. *Atrina janjukiensis* sp. nov. Holotype. Circ. ½ natural size.
Fig. 19. *Atrina janjukiensis* sp. nov. Holotype. Anterior-dorsal view. Circ. ½ natural size.
Fig. 20. *Atrina janjukiensis* sp. nov. Paratype. Dorsal margin. Circ. ½ natural size.